

# Wearable Energy Harvesting system with Multinode

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**Abstract**—Energy harvesting is considered as topic for researcher for different configuration. In this paper we have considered renewable sources such as solar energy and thermoelectric generator for energy harvesting. Solar energy and thermo electric sources are extracted through designed system and stored in battery for other applications. Solar powered clothing is recent development that exists through which power extracted for applications such as mobile charging and other simple devices. The energy extracted from the system is feed to microcontroller for other applications such as detecting gas nearby region, sensing vibration nearby region through motion sensor and in case of panic situations. All these tasks are performed in battle fields. So if we can integrate power unit with control operating unit for above mentioned tasks continuously. So we have design a jacket through which solar and thermo electric units are placed according design and optimal efficiency. According to demand of operations, we have design battery size and capacity of storage. XL6009 can be used for the conversion. The converted electrical energy is stored in the battery pack and then it is used to charge the small devices like night vision goggles, walkie-talkie, and mobile phones.

## I. INTRODUCTION

The term wearable innovation is more extensive than different types of body mounted innovation, since it incorporates gadgets which could conceivably "register," and have been developed with set errands to satisfy one or all the more needs of a particular target group [1]. A more particular arrangement of wearable innovation in connection to attire is called brilliant dress, or intuitive or computerized garments, and is characterized as a "piece of clothing incorporated gadget which augment[2] the usefulness of garments, or which impart[2] data handling usefulness to an article of clothing". Analysts concur that "canny," or "keen," means a capacity to sense boosts from nature, and afterward respond or adjust conduct to the circumstances. In this manner, science has consolidated with style where the property of garments and different data innovation (IT) capacities coincide together in this new reasonable wear.

### A. Solar-Powered Clothing

Sunlight based controlled attire are creative, innovation incorporated items that utilizations sun oriented cell as an option vitality source to produce power to power little compact gadgets. At present, specialists of wearable innovation have moved their essential advantages to sun oriented fuelled attire that can make renewable and wearable vitality sources from sunlight based cells [2]. The alluring elements incorporate being "little, lightweight, adaptable, and rechargeable with high limit and yield". Among the option vitality

sources (e.g. wind, waves), and because of the expanded worry about reliance on oil and coal, the sun turned into the best potential, since it can specifically produce electrical vitality with the guide of sun powered cells. Since a sun based cell produces power specifically from daylight, it is additionally called a photovoltaic cell, signifying "light power;" in this term, "photograph" signifies "light" and "voltaic," beginning from the name of an electrical specialist, Alessandro Volta, implies power. Sunlight based fuelled dress uses the sun oriented cell as an option vitality source to create power. Consequently, reconciliation of photovoltaic materials into attire can give influence to versatile electronic gadgets and opens an abundance of chances for innovation based style.

The main photovoltaic wonders started in 1839 with a revelation of the photovoltaic impact by the French physicist, Antoine-Cesar Becquerel, provoking numerous scientists to create working sun oriented cells with better power change proficiency [2]. Particularly, advancement of sun powered cells in view of adaptable substrates turned into a centre took after by conventional cells, which have numerous limitations because of their thickness and strong substrates. In this manner, as right on time as 1967, flexibilization of silicon sun based cells was proposed to supplant customary strong substrates, and silicon-based slim film sun powered cells turned out to be exceptionally prominent. As of now, numerous studies concentrate on incorporating adaptable sunlight based garments that are 13 lightweight, have great adaptability, and have low creation costs. Sunlight based adaptable boards are made and connected to proper parts of articles of clothing keeping in mind the end goal to gather sun based vitality. To fortify the execution and usefulness, research keeps on creating adaptable cells, for example, photovoltaic materials and fibre-optic sun based cell that can produce power. Despite the fact that sun oriented controlled garments is not broadly popularized, at present the commercial centre (e.g., Silver Lining, Noon, Xunlight, Scottevest Inc.) incorporates clothing with coordinated sun powered cell. Sun powered fuelled apparel offers much usefulness, for example, the photovoltaic coat made by Maier Sports, which can control a mp3 player following three hours charging under the full sun, bringing about over 40 hours of music play time. Alongside individual utilize, this imaginative item is especially helpful for individuals who take an interest in heaps of open air exercises, for example, competitors and officers who invest a considerable measure of energy outside under the sun. Despite the fact that, sun oriented fuelled apparel depends vigorously on daylight and saddles vitality just amid sunshine hours under direct access to the sun's beams, the dress would charge gadgets and store enough vitality for future use without being presented to the daylight. As scientists create more up to date slender film cells with higher productivity and at decreased costs, sun based controlled dress gives incredible chances to innovation incorporated keen garments in the attire business.

### *B. Thermoelectric Generator*

A Thermoelectric generator or TEG (likewise called a Seebeck generator) is a strong state gadget that proselytes heat (temperature contrasts) specifically into electrical vitality through a marvel called the Seebeck impact (a type of thermoelectric impact). Thermoelectric generators capacity like warmth motors. Thermoelectric generators could be utilized as a part of force plants keeping in mind the end goal to change over waste warmth into extra electrical force and in vehicles as car thermoelectric generators (ATGs) to build fuel proficiency.

## II. SYSTEM METHODOLOGY

The block diagram for wearable energy harvesting system with multi node is shown in figure1. Project is expected to set up a multipurpose wearable suit for troopers in military field, safeguard purposes. It is not just utilized for military purposes, can likewise be utilized as a part of mining furthermore by timberland watches. In our project we made utilization of microcontroller PIC 18F46K22J, begin or stop switch, latent infrared movement sensor, gas sensor, GPS beneficiary, GSM modem, sun based board, MPPC LTC3105(converter),thermo electric warmth generators lastly battery pack. Thermoelectric generators (additionally called Seebeck generators) are gadgets that change over warmth (temperature contrasts) straightforwardly into electrical vitality, utilizing a wonder called the Seebeck impact (a type of thermoelectric impact). The XL6009 is a high effectiveness venture up DC/DC converter that can work from info voltages as low as 225mV. A 250mV start-up ability and coordinated most extreme force point controller (MPPC) empower operation straightforwardly from low voltage, high impedance elective force sources, for example, photovoltaic cells, TEGs (thermoelectric generators) and energy components. A client programmable MPPC set point expands the vitality that can be separated from any force source. A latent

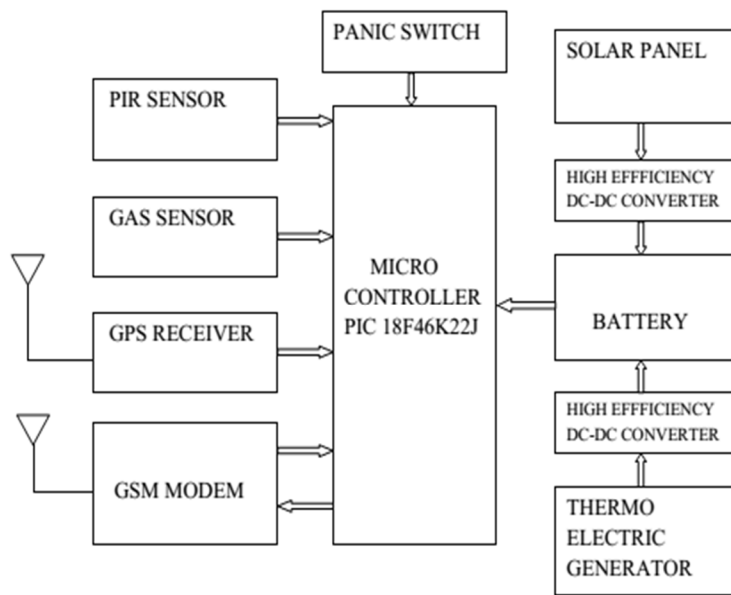


Figure 1: Block diagram of wearable energy harvesting system with multi-nodes

infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light emanating from articles in its field of perspective. An individual PIR sensor identifies changes in the measure of infrared radiation impinging upon it, which shifts contingent upon the temperature and surface attributes of the articles before the sensor.[2] When an item, for example, a human, goes before the foundation. The sensor changes over the subsequent change in the approaching infrared radiation into an adjustment in the yield voltage, and this triggers the location. GPS recipient contains radio wire as its part. The employment of a reception apparatus is to change over vitality in the electromagnetic waves landing from the satellites into electric current that can be taken care of by the hardware in the collector. A GSM modem is a remote modem that works with a GSM remote system. A remote modem carries on like a dial-up modem. The fundamental contrast between them is that a dial-up modem sends and gets information through a settled phone line while a remote modem sends and gets information through radio waves. At the point when a GSM modem is associated with a PC, this permits the PC to utilize the GSM modem to convey over the portable system.

A microcontroller is a little PC on a solitary incorporated circuit containing a processor center, memory, and programmable information/yield peripherals. The PIC structural choices are guided at the augmentation of pace to-cost proportion. The Harvard engineering in which guidelines and information originate from discrete sources—disentangle timing and microcircuit plan significantly, and this advantages clock speed, cost, and power utilization.


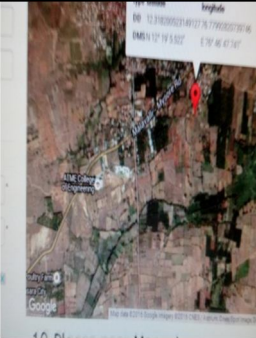
The basic principle of working of the electronic suit involves the following functions: Thermoelectric heat generators detects waste of heat from the environment and is converted into electrical energy. Simultaneously, solar energy from the sun is absorbed by the solar panels and it gets converted into electrical energy. XL6009 can be used for the conversion. The converted electrical energy is stored in the battery pack and then it is used to charge the small devices like night vision goggles, walkie-talkie, and mobile phones. Carbon monoxide gas sensor senses the poisonous gases and indicates the soldiers to aware of enemies. Infrared movement sensor detects movement of the enemies and indicates for the awareness. GPS and GSM modules involves in the transmission of information regarding the soldiers and the battlefield.

### III. RESULT AND DISCUSSION

The accompanying cases were delineated continuously, and results were gotten just about 100% precise through GPS tracker and controller sends the pertinent data & information to concerned client. The proposed system will recognize harmful gasses, for example, butane, carbon monoxide with in 5 feet's reach. In the event that the gas is benefit around encompassing range the sensor will be actuated and will send a sign to the controller. The sign will be of information, for example, longitude and scope estimations of the present

position will be sends through GSM. In any emergency any individual once press the frenzy catch it's take couple of minutes to recognize and send a back rub to controller the move down will be for instance, data of scope and longitude estimation of the present position send through GSM. Is a Motion sensor is a gadget that distinguishes moving articles, especially individuals. A movement sensor is frequently coordinated as a part of a framework that naturally performs an assignment or alarms a client of movement in a zone by utilizing vibration cautions as a part of the framework. The below table I gives an idea about the working prototype of the project model. The following case is studied by taking a lighter as an example which has butane gas inhaled to it.

TABLE I: REAL TIME RESULT SIMULATED

SL.NO	Element detected	Operation of Microcontroller	GSM		GPS Co-Ordinate Location Snap Shot	Location Address	Remarks
			Longitude	Latitude			
1	When a lighter is used as example to make gas sensor to sense Butane as a gas.	Sending Message to GSM as Gas is Been Detected.	7636.69430 E	1221.33702 N		The current venue where testing is been simulated at Mysuru.	Butane Gas is simulated Successful.
2	Panic cases	Sending Message To GSM as Emergence Occurs	7646.37340 E	1218.92943 N		The current venue where testing is been simulated at Mysuru.	Panic Case is simulated Successful.
3	Motion	Movement is detected					Awareness is created by vibration motor

### Comparison of different modes of communications

TABLE II: DIFFERENT MODES OF COMMUNICATION

SL. No.	Particulars	Sampling period	Accuracy
1	GPS	100ms	95%
2	GSM	8ms	98.5%
3	Walkie -Talkie	8ms	32%

The above table II illustrates about different technology operating frequency and data accuracy in obtaining the results. So for our operations, the above mentioned technology gives better results.

### Power Extraction and Load Calculation

So the required amount of power to energize module for continuous operation and it is requirement of power listed bellow in the table. Due to power issues we have adopted two technologies such as solar and thermal electric generator and its power extraction is detailed in table III. In table IV the load distribution of the power is detailed.

TABLE III: POWER EXTRACTION

SL. NO	Power	Voltage in volts	Current in mA	Watts in W
1	Solar Energy	10	500	5
2	TEG	5	320	1.5

TABLE IV: LOAD CALCULATION

SL. NO.	Components	Operating voltage in volts	Operating current in mA	Total power in watts
01	Microcontrollers	5	20	0.1
02	GPS	3.5	100	0.33
03	GSM	5	500	2.5
04	LCD	5	100	0.5
05	PIR Sensor	5	20	0.1
06	Gas sensor	5	80	0.4

#### IV. CONCLUSION

The military uses a lot of fuel amid arrangements and war zone operations. Truth be told, 70% of the gross tonnage transported when the Army conveys ends up being fuel. The Army and Marines additionally have huge and developing combat zone power prerequisites for an assortment of war zone gear that permits them to successfully perform and finish their missions. This front line gear incorporates an assortment of sensors and laser-based reach discoverers and illuminator frameworks, remote interchanges and PC frameworks, worldwide situating frameworks, night-vision hardware, electronic advanced collaborators and information supervisors, and weapon frameworks like warm weapons sights, Javelin hostile to tank rocket launchers, counter mortar radar, and different ambush rifles. These frameworks have power necessities that are normally fulfilled by different battery frameworks. The second part of this developing combat zone power necessity is logistics related; that is, transporting the required fuel and battery weight into and around the war zone theater and discarding the utilized or incompletely utilized batteries after mission fruition. Numerous batteries are discarded with 85% of full charge and add to the developing "battery memorial park". Transporting battery weight into, around, and out of the war zone theater likewise devours fuel and adds to military fuel prerequisites. A few people groups unaccountably are coloring n the front line ,in mining ranges and woods locales because of little reasons. It might because of absence of correspondence between the laborers and higher power officers. Assurance of individual from adversary in front line, from creatures in the woods zones, Poisonous gasses in the mining field s exceptionally troublesome errand. So we had built up this model principally to offer assurance to person. By giving insurance to those individuals we can expect more administrations from those individuals. For the above reasons we had built up a model that incorporate vitality gathering for different military parts for its usefulness. So it is extremely crucial to build up the venture for diminishment of fuel utilization in the specified above field and for security of person in remote zones. For our venture we are collecting a vitality from sun based vitality and from warm vitality. The removed vitality is put away in batteries. In our undertaking we are utilizing progressed created instruments like GPS, GSM, for following reason. Sensors for detecting for noxious gasses, movement sensors for any voyaged living things around us.

##### A. Future Scope

The soldiers are facing lot of difficulties in the battle field. This project will helps in reduction of fuel consumption in a battlefield. We can reduce around 50-60% fuel consumption in a battlefield. At present soldiers are not using any advanced instruments for their protection. If any officer find difficulties to maintain defense secrets this model is very useful in cases. We can easily track the opponent if the problem is given to any soldiers. In borders areas it is very difficult to give a protection to whole country. If sudden attacks made by opponent country we can give information about the situation of what they are facing using GPS, GSM. In mining field also we can give protection to workers from poisonous gases by sensors. In a deep mining field if workers find difficulties we can easily track him by using advanced instrument GPS, GSM. In forest areas also we can give maximum protection to workers.

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